Conceptual Models

and Their Use in Ecosystem Projects

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Upper Mississippi River and Illinois Waterway System

- 5 States, 5+ Federal Agencies
- 3 Districts
- 1,200+ River Miles
- 190,000 mi^2 basin
- 2.7 million acres river & floodplain
- 300,000 acres National Wildlife Refuge

160 million tons of cargo shipped annually
8:1 Transportation savings Benefit:Cost on O&M

More than 11 million recreational visits per year

Complexity of land and water forms...

> 500 fish, herp, bird, and mammal species
> 600 plant species
Plus 10 threatened and endangered

Swan Lake, Illinois River Habitat Restoration

Navigation Study Transition

1993 "Nav study" began – focus of increased navigation

2001 NRC advised expansion of scope to include O&M effects

2001 Corps restructured study and developed vision: sustainability of economic uses and ecological integrity i.e., all resources

UMR – IWW Higher Order Goals

- Second Tier Goals:
  - Maintain viable populations of native species in situ
  - Represent all native ecosystem types across their natural range of variation
  - Restore and maintain evolutionary and ecological processes
  - Integrate human uses and occupancy within these constraints

2003+ Stakeholder meetings, UMRCC

Science Panel Convened

Members of Panel

John Barko	USACE (co-chair)
Ken Lubinski	USGS (co-chair)
Mark Bain	Cornell University
Steven Bartell	Cadmus Group
Gordon Farabe	retired – MO DOC
Robb Jacobson	USGS
Carl Korschgen	USGS
Tatsuaki Nakato	Univ. of Iowa
John Nestler	USACE
Jean O'Neil	USACE
Dave Soballe	USACE

Regional Support Team

Ken Barr	USACE
Clint Beckert	USACE
Bob Clevenstine	USFWS
Rob Davenroy	USACE
Jon Duyvejonck	USFWS
Jon Hendrickson	USACE
Kevin Landwehr	USACE
Chuck Theiling	USACE
Dan Wilcox	USACE

Overall Benefits of Conceptual Models

CMs have been useful in:

- improving communication
- understanding the system modeled
- planning actions

Purposes of a Conceptual Model for the UMR-IWW

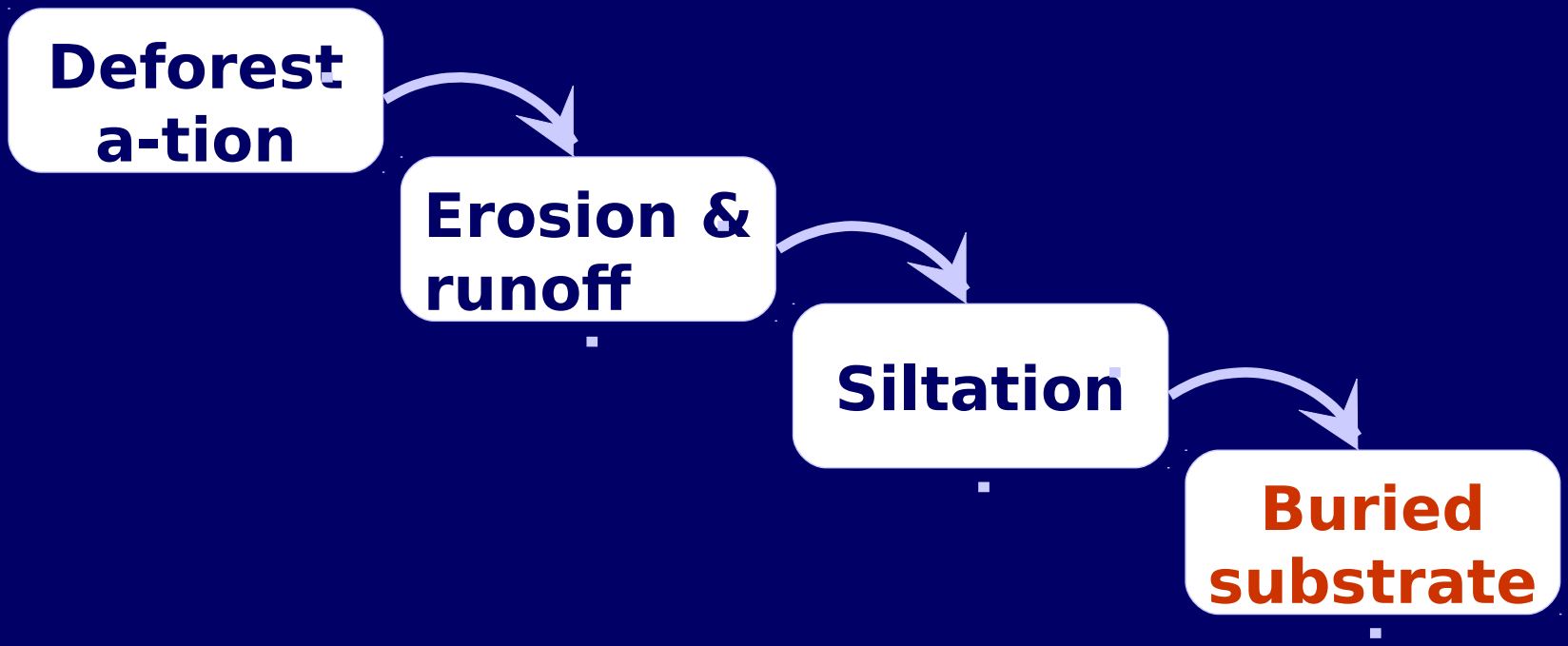
- To visually present a complex system so it can be better understood and managed
- To provide a framework for additional input from stakeholders
- To assist in decisions on impact assessment, restoration and management actions, and evaluation tools

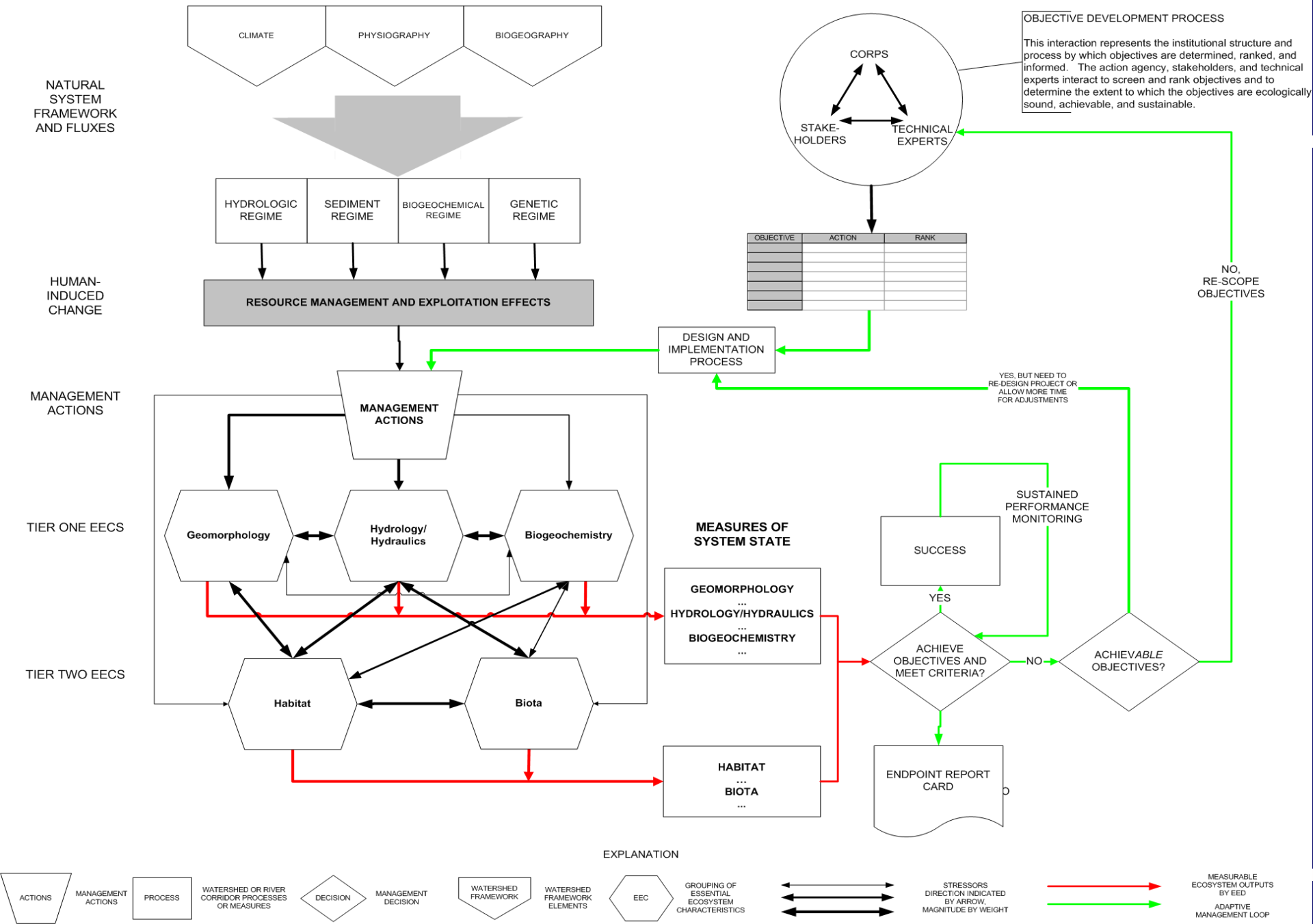
Photo by Hollis All

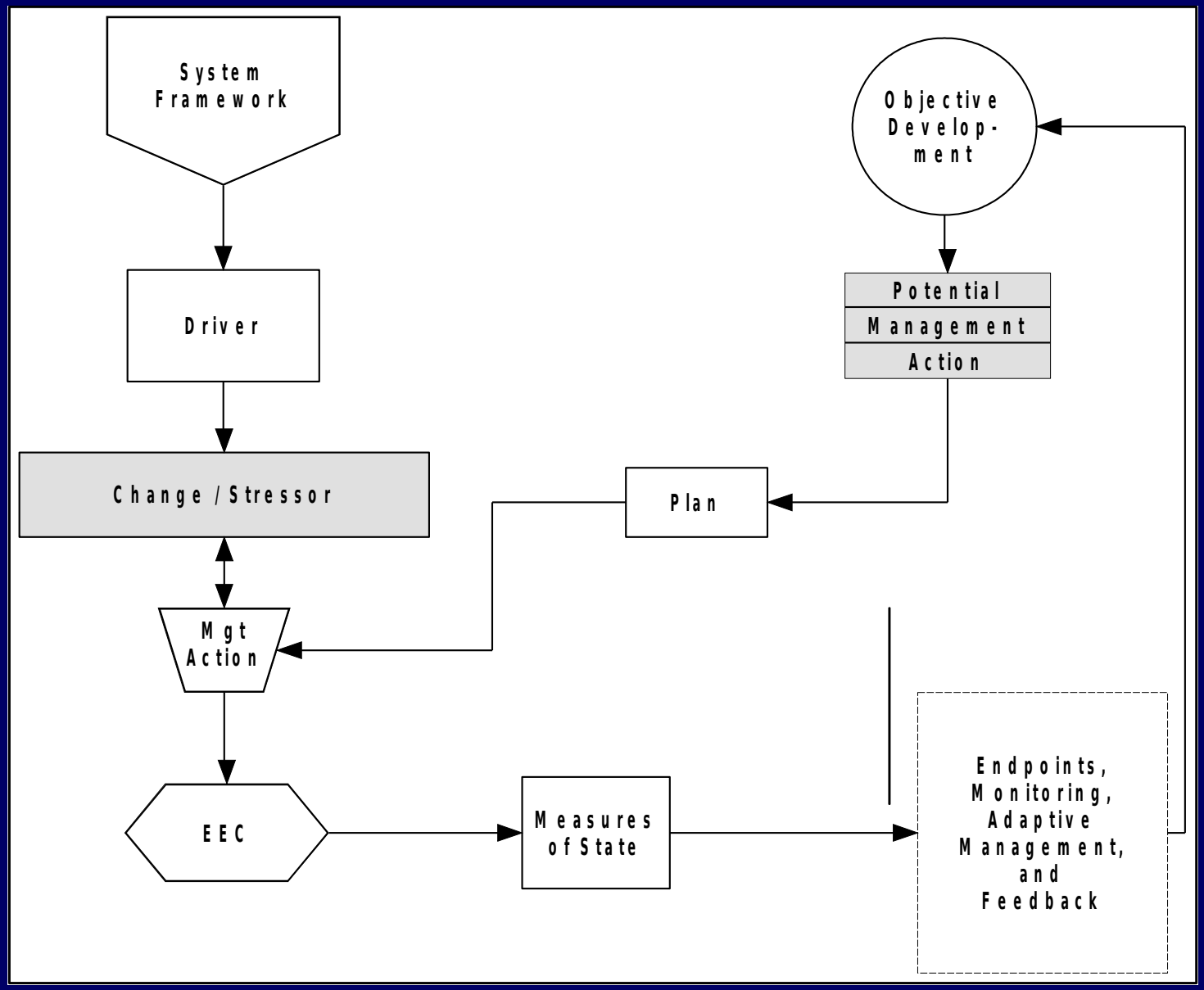
Purposes of the construction…

- To select and portray the major drivers, stressors, and endpoints of the system.
- To portray the major ecological effects of the drivers and stressors on the endpoints, and the mechanisms of effect.
- To show the linkages among the above.

Thought Model




NATURAL SYSTEM FRAMEWORK AND FLUXES
CLIMATE
PHYSIOGRAPHY
BIOGEOGRAPHY
HYDROLOGIC REGIME
SEDIMENT REGIME
BIOGEOCHEMICAL REGIME
GENETIC REGIME
HUMAN-INDUCED CHANGE
RESOURCE MANAGEMENT AND EXPLOITATION EFFECTS
MANAGEMENT ACTIONS
MANAGEMENT ACTIONS
TIER ONE EECS
Geomorphology
Hydrology/ Hydraulics
Biogeochemistry
TIER TWO EECS
Habitat
Biota
MEASURES OF SYSTEM STATE
GEOMORPHOLOGY
...
HYDROLOGY/HYDRAULICS
...
BIOGEOCHEMISTRY
...
HABITAT
...
BIOTA
...
CORPS
STAKE-HOLDERS
TECHNICAL EXPERTS
OBJECTIVE DEVELOPMENT PROCESS
This interaction represents the institutional structure and process by which objectives are determined, ranked, and informed. The action agency, stakeholders, and technical experts interact to screen and rank objectives and to determine the extent to which the objectives are ecologically sound, achievable, and sustainable.
OBJECTIVE
ACTION
RANK
DESIGN AND IMPLEMENTATION PROCESS
NO, RE-SCOPE OBJECTIVES
YES, BUT NEED TO RE-DESIGN PROJECT OR ALLOW MORE TIME FOR ADJUSTMENTS
SUSTAINED PERFORMANCE MONITORING
SUCCESS
YES
ACHIEVE OBJECTIVES AND MEET CRITERIA?
NO
ACHIEVABLE OBJECTIVES?
ENDPOINT REPORT CARD
EXPLANATION
ACTIONS
MANAGEMENT ACTIONS
PROCESS
WATERSHED OR RIVER CORRIDOR PROCESSES OR MEASURES
DECISION
MANAGEMENT DECISION
WATERSHED FRAMEWORK
WATERSHED FRAMEWORK ELEMENTS
EEC
GROUPING OF ESSENTIAL ECOSYSTEM CHARACTERISTICS
STRESSORS DIRECTION INDICATED BY ARROW, MAGNITUDE BY WEIGHT
MEASURABLE ECOSYSTEM OUTPUTS BY EED
ADAPTIVE MANAGEMENT LOOP



Basic construct of UMR-IWW conceptual model

Drivers – the Regimes

Hydrologic	Sediment	Biogeo-chemical	Genetic

Essential Ecosystem Components

Hydrologic	Sediment	Biogeo-chemical	Genetic

Geomorph-ology

Hydrology Hydraulics

Biogeo-chemistry

Habitat

Biota

Stressors – Source of Change

Hydrologic	Sediment	Biogeo-chemical	Genetic

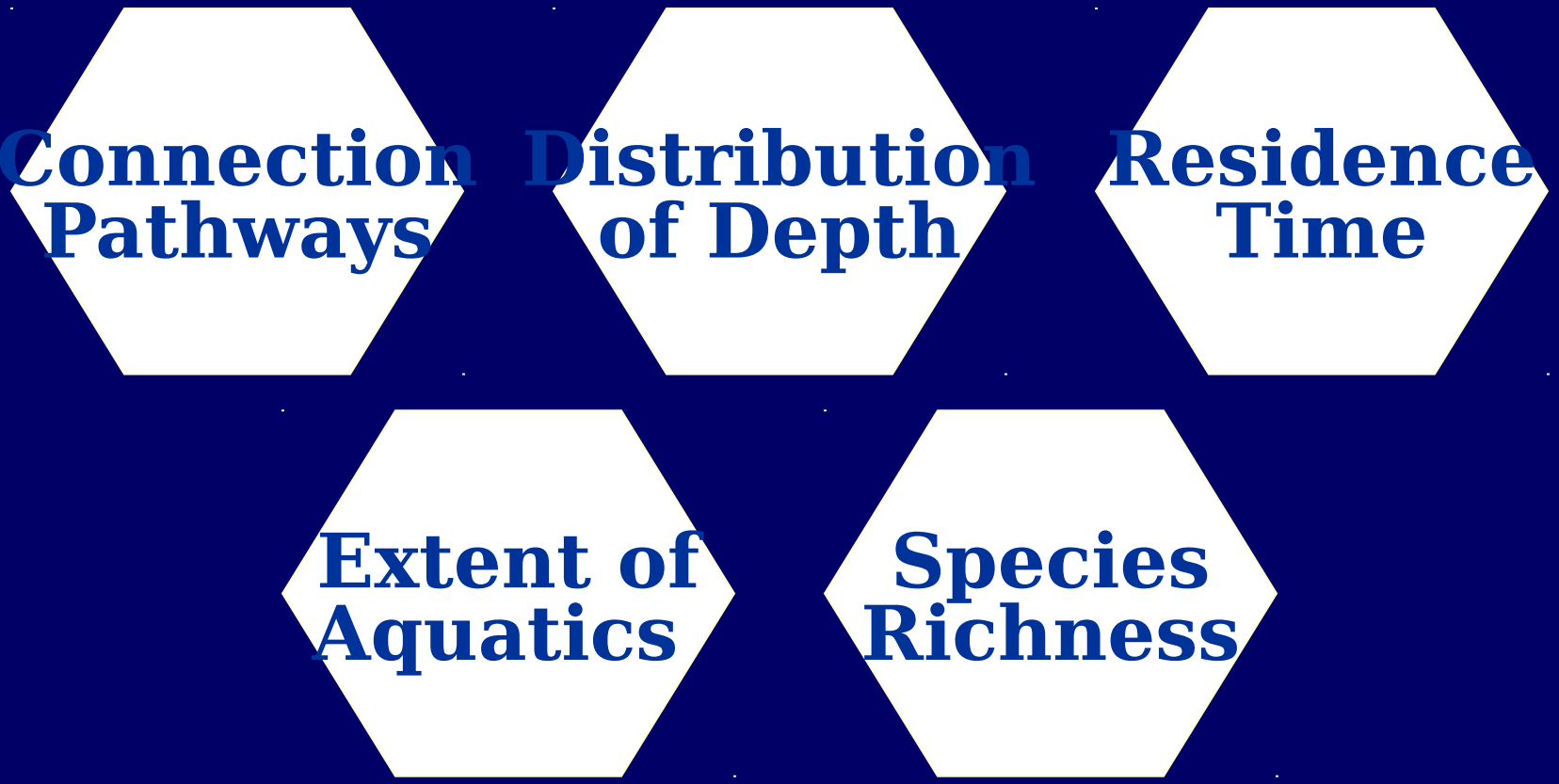
Water table change

Contami-nants

Sediment Resuspension

Fragmentation

Endpoints - Performance



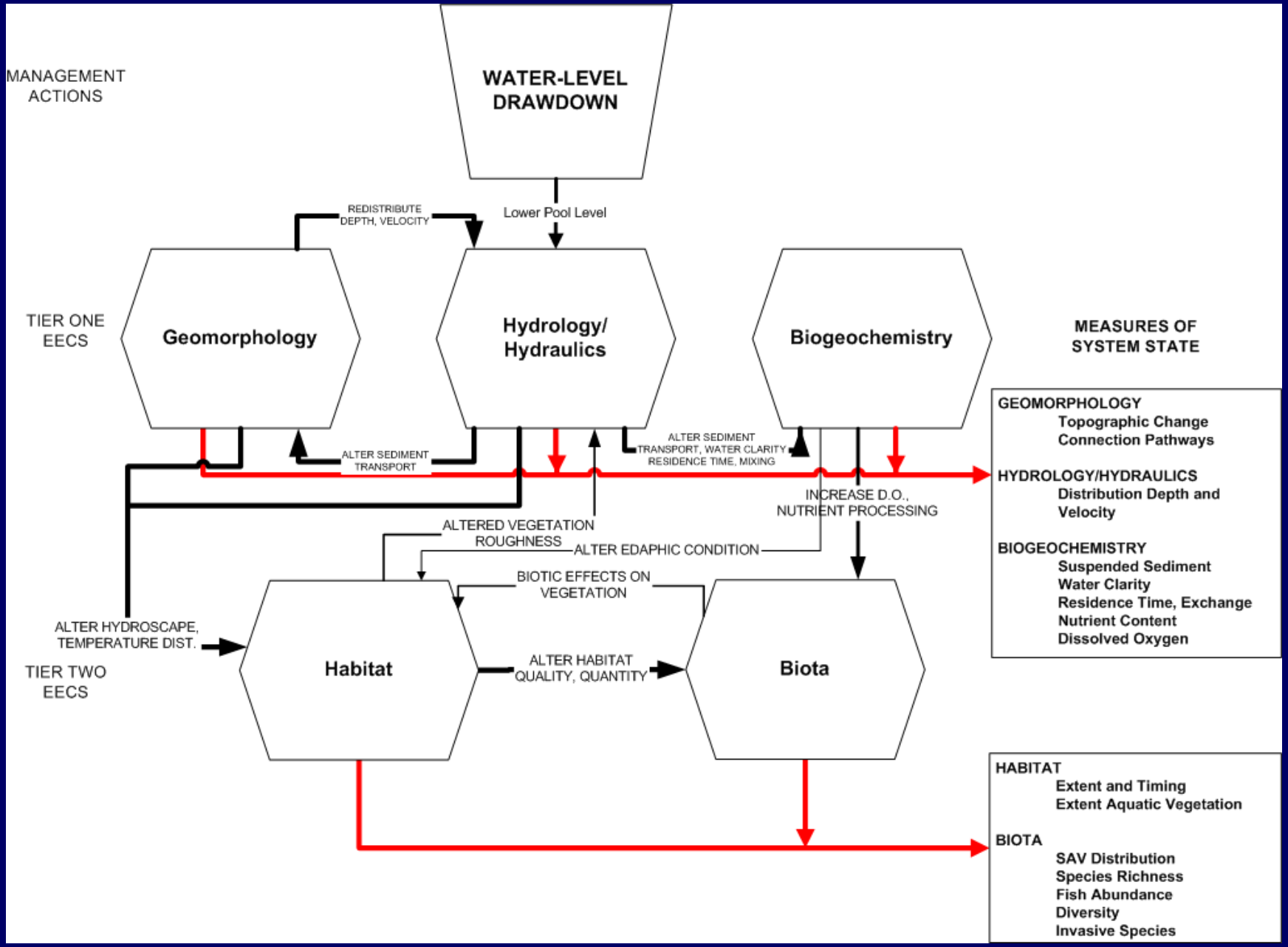
Stressors – Change for What?

	Open Water	Submersed Aquatic Bed	Floating-Leaved Aquatic Bed	Seasonally Flooded Emergent	Wet Meadow
Turbidity					
Anoxia					
Eutrophication					
Erosion					
Deposition					
Sediment Resuspension					
Seasonal Hydrologic Variability					
Non-Point Pollution					
Point-Source Pollution					
Urbanization					
Floodplain Development					

Management Actions

379 actions in 22 classes, e.g.,

- River regulation, dredging, placement of dredged sediments
- Flood damage reduction, floodplain management
- Exotic species, refuge management
- Management of recreation use
- Water supply and water quality


MANAGEMENT ACTIONS
WATER-LEVEL DRAWDOWN
REDISTRIBUTE DEPTH, VELOCITY
Lower Pool Level
TIER ONE EECS
Geomorphology
Hydrology/ Hydraulics
Biogeochemistry
MEASURES OF SYSTEM STATE
ALTER SEDIMENT TRANSPORT
ALTER SEDIMENT TRANSPORT, WATER CLARITY RESIDENCE TIME, MIXING
INCREASE D.O., NUTRIENT PROCESSING
ALTERED VEGETATION ROUGHNESS
ALTER EDAPHIC CONDITION
BIOTIC EFFECTS ON VEGETATION
ALTER HYDROSCAPE, TEMPERATURE DIST.
TIER TWO EECS
Habitat
ALTER HABITAT QUALITY, QUANTITY
Biota
GEOMORPHOLOGY
Topographic Change
Connection Pathways
HYDROLOGY/HYDRAULICS
Distribution Depth and Velocity
BIOGEOCHEMISTRY
Suspended Sediment
Water Clarity
Residence Time, Exchange
Nutrient Content
Dissolved Oxygen
HABITAT
Extent and Timing
Extent Aquatic Vegetation
BIOTA
SAV Distribution
Species Richness
Fish Abundance
Diversity
Invasive Species

sustainability of economic uses and ecological integrity i.e., all resources